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### **Description and Summary of the Canadian, Japanese, and U.S. Joint Data Base of Sablefish Tag Releases and Recoveries During 1977-83**

by  
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Abstract: Scientists from Japan, Canada, the Alaska Department of Fish and Game, and the National Marine Fisheries Service released 270,827 tagged sablefish (Anoplopoma fimbria) in the northeastern Pacific Ocean and the Bering Sea from 1977 through 1983. Information from those releases and the resultant recoveries have been consolidated into a joint data base. The report briefly describes the data base and summarizes information about those releases and recoveries occurring from 1977 through 1983. Most of the tagged fish were released in the Gulf of Alaska (39.1 percent) and off British Columbia (47.1 percent).

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AND RECOVERIES DURING 1977-83

by

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## ABSTRACT

Scientists from Japan, Canada, the Alaska Department of Fish and Game, and the National Marine Fisheries Service released 270,827 tagged sablefish (Anoplopoma fimbria) in the northeastern Pacific Ocean and the Bering Sea from 1977 through 1983. Information from those releases and the resultant recoveries have been consolidated into a joint data base. This report briefly describes the data base and summarizes information about those releases and recoveries occurring from 1977 through 1983.

Most of the tagged fish were released in the Gulf of Alaska (39.1%) and off British Columbia (47.1%). Tag recovery rates ranged from 0.9% in the Bering Sea, where the catch was taken largely by foreign vessels, to 7.6% off Washington, Oregon, and California and 8.0% in British Columbia waters, where domestic exploitation rates are high and the catch is easily accessible to fishery sampling.

The release area composition of recoveries in the International North Pacific Fisheries Commission (INPFC) Southeast and Charlotte Areas, adjusted for the number of tags released in each area, were calculated for fish 157 cm. In the Southeast Area, adjusted recoveries originally tagged in other areas ranged from 54 to 68%. In the Charlotte Area, 39 to 46% of the recoveries were tagged in other areas.

Release and recovery time-location traces showed that small fish had a stronger tendency to be captured north and westward from their release sites than did large fish. Large fish

released in the more westward areas, showed a strong tendency toward clockwise or eastward and southward movement. Large fish released in the southern and eastern areas had no strong tendency to migrate in either direction.

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## INTRODUCTION

Scientists from Japan, Canada, the Alaska Department of Fish and Game (ADF&G), and the National Marine Fisheries Service (NMFS) have released tagged sablefish (Anoolopoma fimbria) over the past several years. The recapture of tagged fish indicates that sablefish can make extensive movements throughout the northeastern Pacific Ocean. There is less agreement, however, as to the degree and consequences of the interchange of fish between regions. Wespestad (1981) reported that interregional migration is small in comparison to stock size within each region, supporting the observations of Low et al. (1976) and Wespestad et al. (1978) that management of the resource is best conducted by region. However, Sasaki (1979) speculates that considerable mixing of sablefish populations occurs in the Gulf of Alaska and they could be considered as one unit for fishery management. When Bracken (1982, 1983) examined data from the NMFS, Japanese, and ADF&G releases, he reported a trend of small sablefish moving northward and large fish moving southward. He conceptualized a model of gulf-wide movement and concluded that the extent of intermixing suggests that Gulf of Alaska sablefish should be considered a single stock for management purposes. Beamish and McFarlane (1983) reported migration of juveniles from British Columbia to waters off Alaska but found no indication of significant movement of adults tagged in Canada. They recommended that adult sablefish in the Canadian zone be managed separately rather than as part of a single stock in the

northeastern Pacific Ocean. Dark (1983) examined the NMFS tagging data from the Washington-California Region (through 1981) and noted a size-related direction of movement and the tendency for less movement off Washington and Oregon than off California.

During the 29th annual meeting of the International North Pacific Fisheries Commission (INPFC) in 1982, participants of the Sablefish Working Group agreed to draft reports on specific topics relating to the current knowledge on sablefish in the northeastern Pacific Ocean. It was clear that many scientists had different views on the status of stocks and on appropriate management strategies. Those differences resulted, in part, from different interpretations of tagging results. It was decided that an all-nation data base of sablefish tag releases and recoveries be constructed and updated periodically to serve as a basis for future analyses.

The purpose of this report is to describe that data base, for the years 1977-83, and to summarize the tagging programs and tag recoveries.

## METHODS

Detailed descriptions of ADF&G tagging methods can be found in Bracken (1981); Canadian methods are in Beamish et al. (1978, 1979, 1980) and Beamish and McFarlane (1983); Japanese methods are in Sasaki (1979, 1980); and NMFS methods are in Shaw (1984, 1986). Nearly all sablefish were tagged with Floy anchor tags. Generally, the gear types used to capture sablefish for tagging by ADF&G were traps and hand-held hook and line gear; by Canada

and NMFS, traps for adults and trawls for juveniles: and by Japan, longlines.

Japan released tagged fish uniformly along the continental slope throughout the Gulf of Alaska and the Bering Sea (during the joint Japan-U.S. longline survey), concentrating on the exploitable size range of fish. Canada released tagged adults mainly off the west coasts of Vancouver and the Queen Charlotte Islands and at the western edge of Queen Charlotte Sound, and tagged juveniles (primarily of the 1977 year class) at Hecate Strait, Queen Charlotte Sound, and coastal inlets of central British Columbia. ADF&G tagged fish in western Behm Canal in southeastern Alaska, initially targeting on juveniles of the 1977 year class as well as a significant portion of 50- to 65-cm fork length (FL) fish. ADF&G and NMFS tagged marketable-size fish in Chatham Strait in southeastern Alaska. Tagging by NMFS was mainly at abundance indexing sites along California, Oregon, Washington, and southeastern Alaska and concentrated on fish at, or near, marketable size.

No consistent or quantitative recovery program existed from 1977 to 1983. Tags were generally recovered by commercial fishery or processing operations. Some agencies have offered monetary tag rewards at various times. Awareness of, and response to, the sablefish tagging study was higher in the Canadian region than in the western Gulf of Alaska and Bering Sea Regions. Limited numbers of recoveries have occurred during research cruises, which provide valuable growth information.

## RESULTS AND DISCUSSION

### Description of Data Base

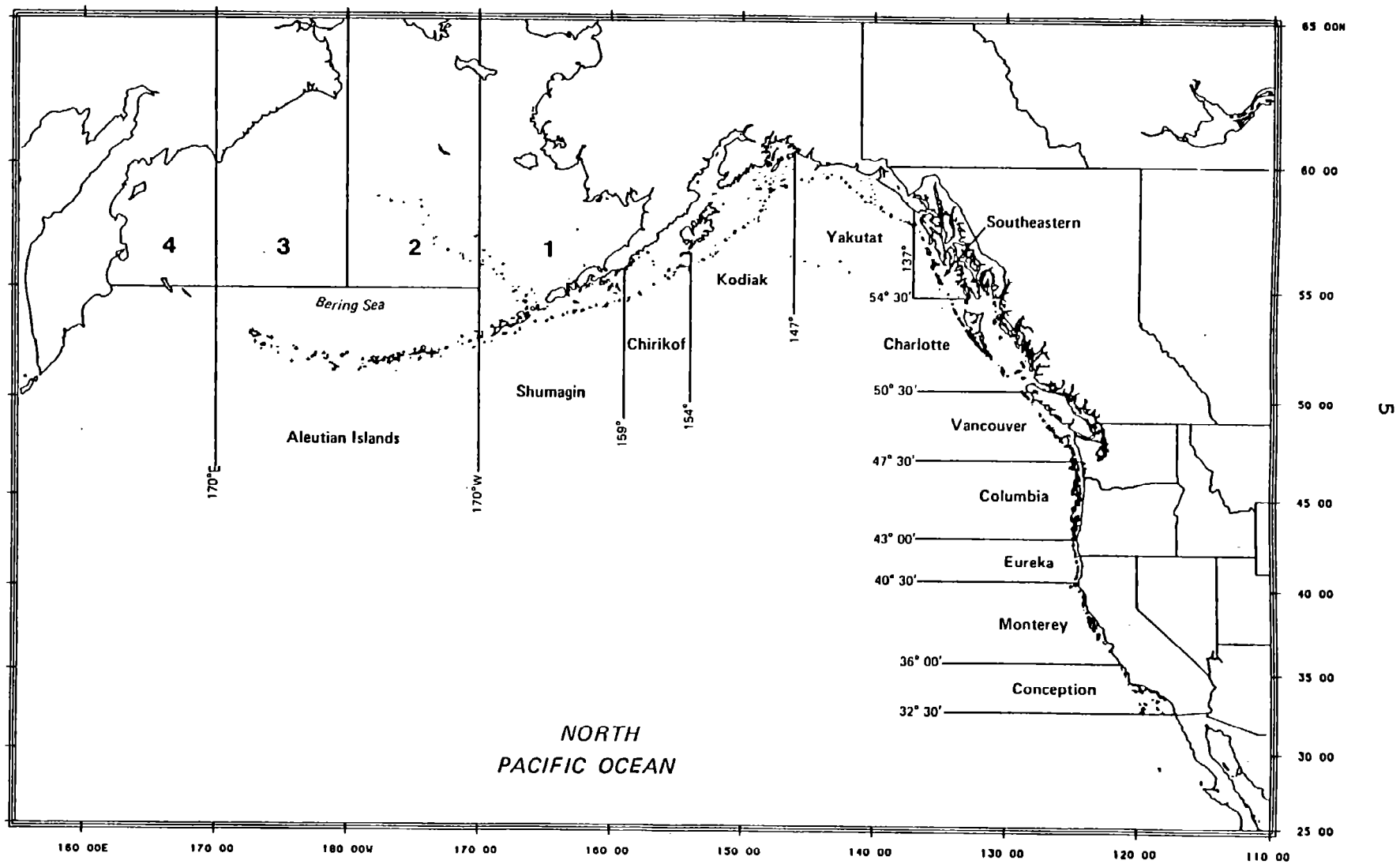
Data are organized into three computer files: 1) Haul records (describing vessel, cruise, haul, and date for each discrete group of fish captured, tagged, and released): 2) tag release records (providing vessel, cruise, haul, tag number, length, and condition for each fish tagged and released): and 3) tag recovery records (providing tag number, date, location, length, nation, and gear for each tagged fish). Integral to the data base are numerous auxiliary computer programs (see Appendix) for manipulating the data files and records. These programs can list, search, print, convert, merge, select, sort, and plot specified records.

Development of the data base system, conversion of original data files, and editing and maintenance of the data have been performed by the Northwest and Alaska Fisheries Center (NWAFC) Resource Assessment and Conservation Engineering (RACE) Division. For the period 1977 to 1983, the release records total 270,827 fish, and recovery records total 14,643 fish.

### Release Data

The general release locations of tagged sablefish are shown in Figure 1. Of the 270,827 releases, 124,517 (46%) were released by Canada, 28,280 (10%) by NMFS, 14,869 (6%) by ADF&G, 100,696 (37%) by the Japan-U.S. joint longline survey, 1,262 (0.5%) by the Republic of Korea, and 1,203 (0.4%) by unknown or miscellaneous sources.

Figure 1.--Locations of tagged sablefish (*Anoplopoma fimbria*) releases in the northeastern Pacific Ocean and Bering Sea in 1977-83.



The geographical distribution of the releases by INPFC statistical areas are as follows: 16,138 (6.0%) from Conception to Columbia Areas; 127,684 (47.1%) in the Vancouver and Charlotte Areas; 105,956 (39.1%) in the Gulf of Alaska from the Southeastern Area to the Aleutian Islands; 19,908 (7.4%) in the Bering Sea; and 1,141 (0.4%) in undetermined areas (Table 1).

#### Recovery Data

A total of 14,643 tagged sablefish were recovered between 1977 and 1983 from releases during the same period. Figure 2 illustrates recovery locations and Table 1 lists sablefish tag recoveries by release and recovery areas. Releases in the Pacific Region (Conception to Columbia INPFC Areas) and the Canadian Region (Vancouver and Charlotte INPFC Areas) were recovered at higher rates than were releases in the Gulf Region (Southeastern to Shumagin INPFC Areas and the Gulf of Alaska side of the Aleutian Area) and the Bering Sea Region (Table 2).

The differences in recoveries may be due to higher reporting rates in the Pacific and the Canadian Regions. The Canadian Region is commonly considered to have a much higher reporting rate than the Gulf of Alaska. Presumably, the reporting rate for the Bering Sea is similar to or less than the Gulf Region, based on sampling conditions and the domestic share of the catch. On the other hand, the Pacific Region is similar to the Canadian Region in these factors. Information from McDevitt (1986) (Table 3) shows that the Pacific and Canadian Regions had considerably higher proportions of domestic catch and higher



Table 1. --Sablefish tag recoveries from 1977-83 by International North Pacific Fisheries Commission release site and recovery area. Numbers in parentheses are percentage of recoveries.

Release site	Fish released (no.)	Recovery (no.) by area							
		Concep- tion	Monterey	Eureka	Columbia	Vancouver	Charlotte	Southeast	Yakutat
Conception	7,730	287 (69)	79 (19)	26 (6)	12 (3)	5 (1)	5 (1)	1 (<1)	0
Monterey	1,587	1 (1)	92 (70)	18 (14)	13 (10)	1 (1)	1 (1)	1 (1)	1 (1)
Eureka	581	0	1 (2)	44 (71)	16 (26)	1 (2)	0	0	0
Columbia	6,240	1 (<1)	8 (1)	30 (5)	512 (83)	35 (6)	9 (1)	4 (1)	5 (1)
Vancouver	25,398	0	2 (<1)	6 (<1)	44 (2)	1,706 (64)	800 (30)	31 (1)	26 (1)
Charlotte	102,286	0	5 (<1)	2 (<1)	34 (<1)	1,004 (13)	5,717 (76)	236 (3)	166 (2)
Southeast	42,646	0	2 (<1)	1 (<1)	13 (1)	92 (5)	376 (20)	1,165 (62)	116 (6)
Yakutat	21,288	0	0	1 (1)	3 (1)	8 (2)	38 (10)	63 (16)	179 (46)
Kodiak	16,861	0	0	1 (<1)	6 (2)	12 (4)	40 (13)	32 (10)	42 (14)
Chirikof	11,428	0	0	0	4 (2)	18 (8)	23 (11)	23 (11)	18 (8)
Shumagin	13,296	0	0	2 (1)	6 (2)	15 (6)	38 (14)	25 (9)	21 (8)
Eastern									
Bering	10,115	0	0	1 (1)	4 (4)	4 (4)	2 (2)	2 (2)	0
Bering2	2,861	0	0	0	0	0	0	0	0
Aleutians									
-Bering	6,932	0	0	0	1 (1)	2 (3)	14 (19)	9 (12)	7 (9)
Aleutians									
-Gulf	437	0	0	0	1 (10)	0	0	2 (20)	0
	<u>269,686</u>	<u>289</u>	<u>189</u>	<u>132</u>	<u>668</u>	<u>2,903</u>	<u>7,063</u>	<u>1,593</u>	<u>581</u>



Table 1. --Continued.

Release site	Fish released (no.)	Recovery (no.) by area								
		Kodiak	Chirikof	Shuma- gin	Eastern Bering	Bering2	Aleutians -Bering	Aleutians -Gulf	Un- known	Total
Conception	7,730	0	0	1(<1)	0	0	0	0	1	416
Monterey	1,587	1(1)	0	1(1)	1	0	0	0	2	132
Eureka	581	0	0	0	0	0	0	0	0	62
Columbia	6,240	0	3(<1)	4(1)	0	3(<1)	0	1(<1)	0	615
Vancouver	25,398	16(1)	11(<1)	6(<1)	3(<1)	3(<1)	0	1(<1)	0	2,655
Charlotte	102,286	116(2)	70(1)	65(1)	37(<1)	30(<1)	18(<1)	1(<1)	0	7,500
Southeast	42,646	58(3)	26(1)	16(1)	14(1)	2(<1)	9(<1)	0	0	1,890
Yakutat	21,288	42(11)	18(5)	19(5)	8(2)	2(1)	6(2)	2(1)	0	389
Kodiak	16,861	127(41)	18(6)	8(3)	9(3)	7(2)	6(2)	0	0	308
Chirikof	11,428	32(15)	59(27)	25(12)	5(2)	5(2)	2(1)	1(<1)	0	215
Shumagin	13,296	27(10)	22(8)	82(31)	10(4)	11(4)	4(2)	0	0	263
Eastern Bering	10,115	4(4)	2(2)	8(8)	63(64)	7(7)	1(1)	0	0	98
Bering2	2,861	0	0	0	2(13)	13(87)	0	0	0	15
Aleutians -Bering	6,932	4(5)	2(3)	3(4)	5(7)	3(4)	24(32)	1(1)	0	75
Aleutians -Gulf	437	1(10)	0	1(10)	1(10)	1(10)	1(10)	2(20)	0	10
	269,686	428	231	239	157	87	71	9	3	14,643

Table 2. --Distribution of sablefish tagged in the northeastern Pacific in 1977-83  
by International North Pacific Fisheries Commission region.  
Percentages are in parentheses.

	Distribution of tagged sablefish by region					Total
	Pacific	Canadian	Gulf	Bering Sea- Aleutian	Un- known	
Recovery distribution of recovered tags	1,278 (8.7)	9,966 (68.1)	3,081 (21.0)	315 (2.2)	3	14,643
Release distribution of recovered tags	1,225 (8.4)	10,155 (69.4)	3,075 (21.0)	188 (1.3)	0	14,643
Release distribution of all released tags	16,138 (6.0)	127,684 (47.1)	105,956 (39.1)	19,908 (7.4)	1,141 (0.4)	270,827
Recovery rate	.076	.080	.029	.009		.054

Table 3. --Catch, units of habitat, and catch per unit habitat for sablefish in northeastern Pacific Ocean during 1977-83 by International North Pacific Fisheries Commission regions.

	Pacific	Canadian	Gulf <sup>a</sup>	Bering-Aleutian
Catch (t) by region <sup>b</sup>				
U.S.	85,140	9,541	17,374	259
Canada	0	20,026	4	0
Total domestic	85,140	29,567	17,378	259
Foreign	1,167	6,486	55,011	21,651
Total (domestic and foreign)	86,307	36,052	72,386	21,910
Habitat (nm <sup>2</sup> ) <sup>c</sup>	18,846	11,109	20,968	30,296
Habitat (nm) <sup>c</sup>	1,356	805	2,199	4,193
Total catch (t)/nm <sup>2</sup>	4.6	3.2	3.4	0.70
Domestic catch/nm <sup>2</sup>	4.5	2.7	0.8	0.01
Domestic catch/nm	62.8	36.7	7.9	0.06

<sup>a</sup>The gulf side of the Aleutian Area is included in the Bering/Aleutian region, whereas it is included in the Gulf Region in the text and in Table 2.

<sup>b</sup>McDevitt (1986).

<sup>c</sup>Measured as square nautical miles (nm<sup>2</sup>) of surface between 200 m and 1,000 m depths or length (nm) of 1,000 depth contour.  
Source: S. A. McDevitt, Northwest and Alaska Fisheries Center, REFM Division, 7600 Sand Point Way NE, Bin C15700, Seattle, WA 98115 (pers. commun., 1986).

proportions of domestic catch per unit habitat than did the Gulf and the Bering Regions. The Bering Region had a distinctly lower value in total catch per unit habitat. The Southeastern INPFC Area, of all areas in the Gulf and Bering Regions, was the most similar to the Pacific and Canadian Regions in sampling conditions and domestic fisheries in 1977-83. The Southeastern Area also had the highest recovery rate of all areas in the Gulf and Bering regions during that time. In fact, Dark (1983) noted that for NMFS releases, Alaska (mainly from the Southeastern Area) had a recovery rate higher than that of either Oregon, Washington, or California.

Another explanation for different tag recovery rates between regions may be differences in tagging mortality due to method of capturing fish for tagging. Except for NMFS and ADF&G releases in the Southeastern Area, the fish released in the Gulf and Bering Regions were captured by longlines, while marketable-size fish released in the Canadian and Pacific Regions were caught mainly by traps. In summary, the higher recovery rates have occurred where, but not necessarily because, domestic exploitation rates were high, catch landing operations were easily accessible to fishery sampling, and the releases of marketable-size fish were of fish captured by traps, or hand-held hook and line gear.

Table 4 shows the number of recoveries compared to releases by release area, tagging agency or country, tag series, and size (<57 vs. 257 cm FL). Data here suggest that small fish (<57 cm) are recovered at a lower rate than large fish, and little

Table 4. --Recoveries and releases of tagged sablefish (Anoplopoma fimbria) <57 or >57 cm fork length (FL) at time of release by Canada, Japan, and the United States in 1977-83 in the northeastern Pacific Ocean. Releases are in parentheses.

Tag area	Agency or country	Tag series	Fish size	Recovery/release (no.) by year						
				1977	1978	1979	1980	1981	1982	1983
Conception	NMFS	SA	<57				317 (5,594)	15 (694)	1 (415)	
	NMFS	SA	≥57				94 (861)	5 (106)	0 (60)	
Monterey	NMFS	SA	<57				31 (428)		32 (540)	
	NMFS	SA	≥57				12 (219)		18 (223)	
										13
Eureka	NMFS	SA	<57							23 (556)
	NMFS	SA	≥57							4 (25)
Columbia	NMFS	SA	<57			35 (610)	120 (1,527)	90 (1,387)		18 (1,214)
	NMFS	SA	≥57			35 (305)	106 (675)	45 (454)		2 (67)
Vancouver	NMFS	SA	<57			42 (507)	52 (627)	17 (370)		2 (76)
	NMFS	SA	≥57			29 (295)	37 (275)	9 (124)		2 (43)
	Canada	77, 78 or 82	<57	55 (2,520)	12 (165)	192 (1,900)	72 (1,255)		14 (653)	
	Canada	77, 78 or 82	≥57	139 (3,444)	238 (3,082)	1,119 (5,169)	654 (3,006)		252 (2,285)	

Table 4. --Continued.

Tag area	Agency or country	Tag series	Fish size	Recovery/release (no.) by year						
				1977	1978	1979	1980	1981	1982	1983
Charlotte	Japan	JU	<57			1 (42)	0 (47)	0 (22)	0 (14)	
	Japan	JU	≥57			3 (137)	14 (336)	0 (49)	0 (157)	
	Japan	SA	<57					1 (64)	0 (6)	1 (20)
	Japan	SA	≥57					5 (281)	0 (11)	1 (157)
	Canada	PI	<57						14 (371)	
	Canada	PI	≥57						29 (652)	
	Canada	77, 78 or 82	<57	23 (149)	41 (429)	554 (27,851)	1,141 (18,786)	318 (15,498)	21 (1,093)	
	Canada	77, 78 or 82	≥57	1,268 (5,054)	773 (7,335)	1,564 (6,746)	1,136 (7,384)	832 (7,410)	279 (2,058)	
	NMFS	AB	<57							25 (794)
	NMFS	AB	≥57							123 (1,714)
South-eastern	NMFS	SA	<57		0 (78)	16 (219)	13 (282)	53 (1,012)	13 (332)	
	NMFS	BB, BX	≥57		6 (513)	222 (1,508)	124 (1,082)	127 (1,200)	31 (324)	
	ADF&G	A, Z	<57			249 (5,826)	26 (853)	90 (2,136)		8 (1,640)
	ADF&G	A, Z	≥57			39 (574)	33 (395)	230 (2,284)		26 (1,160)
	Japan	JU	<57		2 (37)	3 (316)	0 (67)	6 (509)	7 (556)	3 (325)
	Japan	JU	≥57		34 (1,093)	77 (2,265)	0 (1)	31 (1,487)	28 (766)	14 (675)

Table 4. --Continued.

Tag area	Agency or country	Tag series	Fish size	Recovery/release (no.) by year						
				1977	1978	1979	1980	1981	1982	1983
Yakutat	Japan	SA	<57			5 (317)	14 (1,270)	11 (796)	4 (425)	3 (220)
	Japan	SA	≥57			81 (2,296)	58 (1,451)	34 (1,694)	19 (762)	31 (882)
	Japan	JU	<57		6 (232)	8 (362)	20 (1,120)	12 (937)	7 (502)	5 (447)
	Japan	JU	≥57		41 (1,843)	54 (1,802)	41 (1,258)	47 (1,474)	34 (996)	11 (552)
	Japan	SA	<57			8 (356)	5 (327)	11 (733)	12 (992)	1 (332)
	Japan	SA	≥57			59 (2,028)	19 (560)	38 (1,422)	22 (1,082)	16 (738)
	Japan	JU	<57		2 (86)	2 (12)	17 (828)	8 (659)	16 (822)	6 (529)
	Japan	JU	≥57		46 (1,679)	7 (168)	46 (1,208)	29 (1,041)	24 (1,175)	16 (1,337)
	Japan	SA	<57			13 (320)	2 (132)	5 (568)	9 (649)	4 (508)
	Japan	SA	≥57			52 (1,172)	14 (246)	30 (960)	29 (1,064)	28 (961)
Chirikof	Japan	JU	<57		0 (38)		8 (230)	10 (466)	1 (404)	2 (338)
	Japan	JU	≥57		38 (927)		24 (583)	26 (863)	9 (591)	7 (778)
	Japan	SA	<57			15 (517)	5 (207)	5 (290)	4 (430)	0 (316)
	Japan	SA	≥57			48 (1,232)	29 (643)	11 (497)	28 (1,090)	6 (795)

Table 4.--Continued.

Tag area	Agency or country	Tag series	Fish size	Recovery/release (no.) by year						
				1977	1978	1979	1980	1981	1982	1983
Shumagin	Japan	JU	<57		1 (85)		8 (608)	11 (654)	8 (388)	4 (233)
	Japan	JU	≥57		27 (971)	57 (998)	16 (456)	22 (772)	10 (752)	
	Japan	SA	<57			11 (571)	0 (19)	11 (493)	10 (688)	2 (531)
	Japan	SA	≥57			66 (1,001)	2 (54)	36 (1,184)	39 (1,524)	13 (1,027)
E. Bering	Japan	JU	<57				0 (79)	1 (49)	3 (535)	5 (656)
	Japan	JU	≥57				0 (52)	6 (161)	18 (620)	9 (1,421)
	Japan	SA	<57			1 (58)		0 (23)	14 (1,432)	5 (821)
	Japan	SA	≥57			7 (183)		3 (55)	41 (2,322)	18 (1,983)
Bering Area 2	Japan	JU	<57							3 (218)
	Japan	JU	≥57							7 (745)
	Japan	SA	<57						1 (352)	0 (32)
	Japan	SA	≥57						18 (1,431)	1 (83)
Aleutians	Japan	JU	<57				3 (791)	4 (622)	5 (1,049)	2 (211)

16



Table 4.--Continued.

Tag area	Agency or country	Tag series	Fish size	Recovery/release (no.) by year						
				1977	1978	1979	1980	1981	1982	1983
Bering	Japan	JU	≥57				4 (239)	3 (349)	8 (1,236)	5 (460)
	Japan	SA	<57			3 (96)		5 (624)		1 (82)
	Japan	SA	≥57			24 (517)		7 (298)		5 (313)
Aleutians	Japan	JU	<57					1 (193)		
Gulf of Alaska	Japan	JU	≥57					2 (71)		

difference exists in recovery rates between the tags labeled NMFS (SA series) and Japan (JU series) released during the Japan-U.S. cooperative longline survey. However, recovery rates of the SA series tags released during the U.S. -Japan cooperative longline survey off southeastern Alaska are lower than those tagged fish released during cruises of the NMFS in southeastern Alaska. This difference may be due to the fact that some of the NMFS releases were in inside waters where intense fishing and better port sampling occur. Differences in recovery rates between small and large fish may be due to differences in tagging mortality caused by the capture gear (many of the small fish were caught by trawls, while large fish were caught mainly by traps and longlines), or differences in exploitation rate (the sablefish catch is taken mainly by longline and trap fisheries targeting on larger fish).

The directionality of tagged fish movements following release is summarized in Table 5. As expected, releases from the northwestern end of the geographic range tended to be recovered to the south or east of the release area,, whereas releases from the south end of the range tended to be recovered north of the release area. Further, the proportion of recaptures within the same area as release tended to be higher in the southern areas than in the western areas. This tendency may be due to a higher recapture rate for fish remaining in the area of release in some of the southern areas where much of tagging effort and some of the recapture fishery seem concentrated in discrete locations (Figs. 1 and 2).

Table 5. --Percentage of tagged sablefish (Anoplopoma fimbria) recovered in the International North Pacific Fisheries Commission (INPFC) statistical area of release, north or west, or south or east of the area of release in 1977-83.

INPFC release area	Recovery (%)		
	North or west of release area	Release area	South or east of release area
Conception	31	69	--
Monterey	29	70	1
Eureka	27	71	2
Columbia	11	83	6
Vancouver	34	64	2
Charlotte	10	76	14
Southeastern	13	62	25
Yakutat	25	46	29
Kodiak	16	41	43
Chirikof	18	27	55
Shumagin	10	31	59
Eastern Bering Sea	8	64	28
Bering 2	--	87	13
Aleutians-Bering	4	32	64
Aleutians-Gulf	20	20	60

Release Composition of Recoveries  
in the Southeastern and Charlotte Areas

The release area composition of tags recovered in the Southeastern and Charlotte INPFC Areas in 1979-83, for fish 157 cm FL at the time of release, is presented in Tables 6 and 7, respectively. Only tagged fish released during the Japan-U.S. joint longline survey or by Canada are used here, to minimize the effects of differences in tagging and release methods. The maximum time to recovery is 5 years for these fish. The release area composition of recoveries adjusted for number of releases is the estimated recovery composition that would result if the same number of tagged fish had been released each year in each area. For example, in Table 6, 25 of the fish released from the Yakutat Area (one fish released in 1978, five in 1979, eight in 1980, eight in 1981, and three in 1982) were recovered in the Southeastern Area in 1983. Because releases from the Yakutat Area equaled 1,843 in 1978, 3,830 in 1979, 1,818 in 1980, 2,896 in 1981, and 2,078 in 1982 (Table 4), the adjusted recoveries per 1,000 fish released per year are 0.54, 1.31, 4.40, 2.76, and 1.44, respectively. Thus, the total for the 1983 adjusted recoveries in the Southeastern Area, originating from the Yakutat Area, equals 10.45, which is 12% of the total 90.20 adjusted recoveries from all release areas. Of these, 28.6 (32%) originated from the Southeastern Area. Thus, an estimated 68% of the adjusted number of tagged fish recovered were tagged in other areas. The percentages of southeast recoveries, which were tagged outside the Southeastern Area, were 64 for 1981 and 54 for 1982.

Table 6. --Release area composition of tagged sablefish (*Anoolopoma fimbria*) recovered in the International North Pacific Fisheries Commission Southeastern Area in 1979-83 for fish 257 cm fork length at time of release. Recoveries per 1,000 tagged fish released per area per year are in parentheses; the area composition is shown in percent. Only releases from the Japan-U.S. joint longline survey in the Gulf of Alaska and Bering Sea Areas and Canadian tagging in the Charlotte and Vancouver Areas are used here.

Release area	Recovery (no.) by year				
	1979	1980	1981	1982	1983
Vancouver	3( 0.97)10%	7( 1.62) 7%	3( 0.74) 1%	2( 0.39) 1%	8( 2.74) 3%
Charlotte	8( 1.09)11%	14( 2.01) 8%	15( 2.12) 4%	35( 4.80)12%	47(11.70)13%
Southeast	5( 4.67)47%	31( 8.19)33%	46(20.20)36%	43(19.10)46%	65(28.60)32%
Yakutat	1( 0.54) 5%	9( 3.48)14%	6( 2.13) 4%	7( 2.37) 6%	25(10.45)12%
Kodiak	1( 0.60) 6%	---	5( 3.47) 6%	5( 3.08) 8%	18( 9.59)11%
Chirikof	2( 2.16)22%	2( 2.16) 9%	5( 5.13) 9%	8( 6.51)16%	5( 4.03) 4%
Shumagin	---	5( 5.06)21%	7( 6.96)13%	3( 3.00) 7%	9( 7.65) 8%
E. Bering	---	---	2(10.90)20%	---	---
Bering 2	---	---	---	---	---
Aleutians/ Bering Sea	---	1( 1.93) 8%	2( 3.87) 7%	1( 1.93) 5%	3( 4.29) 5%
Aleutians/ Gulf	---	---	---	---	1(11.10)12%
Total	20(10.00)	69(24.45)	91(55.50)	104(41.20)	181(90.20)

Table 7. --Release area composition of tagged sablefish (*Anoplopoma fimbria*) recovered in the International North Pacific Fisheries Commission Charlotte Area in 1979-83 for fish 157 cm fork length at time of release. Recoveries per 1,000 tagged fish released per area per year are in parentheses: the area composition is shown in percent. Only releases from the Japan-U.S. joint longline survey in the Gulf of Alaska and Bering Sea Areas and Canadian tagging in the Charlotte and Vancouver Areas are used here.

Release area	Recovery (no.) by year				
	1979	1980	1981	1982	1983
Vancouver	32(10.4)25%	185( 37.3)36%	179( 42.1)24%	64( 17.4)14%	72( 24.6)12%
Charlotte	159(21.7)53%	362( 52.6)51%	665( 92.4)54%	571( 77.8)61%	459(127.0)60%
Southeast	---	4( 0.9) 1%	11( 6.6) 4%	8( 5.0) 4%	8( 3.0) 1%
Yakutat	2( 1.1) 3%	7( 2.6) 3%	4( 1.9) 1%	7( 3.2) 3%	10( 4.0) 2%
Kodiak	4( 2.4) 6%	4( 2.4) 2%	13( 8.8) 5%	6( 3.6) 3%	12( 7.8) 4%
Chirikof	5( 5.4)13%	1( 1.1) 1%	7( 6.5) 4%	1( 1.1) 0%	8( 6.5) 3%
Shumagin	---	4( 4.1) 4%	10( 10.1) 6%	11( 10.9) 9%	13( 12.0) 6%
E. Bering	---	---	---	---	2( 9.1) 4%
Bering 2	---	---	---	---	---
Aleutians/ Bering Sea	---	1( 1.9) 2%	2( 3.9) 2%	3( 8.1) 6%	7( 15.4) 7%
Aleutians/ Gulf	---	---	---	---	---
Total	202(41.0)	568(102.9)	891(172.3)	671(127.1)	591(209.4)

These values are not adjusted for the relative population size between areas, or for the reporting rate but, nevertheless, are an indication of strong interarea mixing.

Recoveries in the Charlotte Area, when adjusted as explained above, show that 46% in 1981, 39% in 1982, and 40% in 1983 were released outside the Charlotte Area.

#### Time-Location Traces

Time-location traces of tagged fish are shown for releases by Japan (Fig. 3), Canada (Fig. 4, randomly subsampled for graphic purposes), ADF&G (Fig. 5), and NMFS (Fig. 6) for three size categories: small (<57 cm), medium (>57 cm but <67 cm), and large (167 cm). The horizontal axis of the graph represents locations of releases and recoveries as measured linearly from 180°W longitude on the Pacific side of the Aleutian Islands, along the continental slope to the southern border of California. The vertical axis represents chronological time from 1977 to 1983. Thus, a recovered tag can be represented as a directed line segment or trace connecting the release and recovery coordinates of location and time. For example, Japan (Fig. 3) released small fish at a site in the western Yakutat Area in 1978: One fish was recovered in the southern Charlotte Area about mid-1982, another was recovered at or near the release site late in 1979, and a third at the western end of the Chirikof Area early in 1980. These graphs are intended to provide an efficient presentation of the data with a minimum of summarization and analysis, to allow the reader to judge the quality and significance of the data.

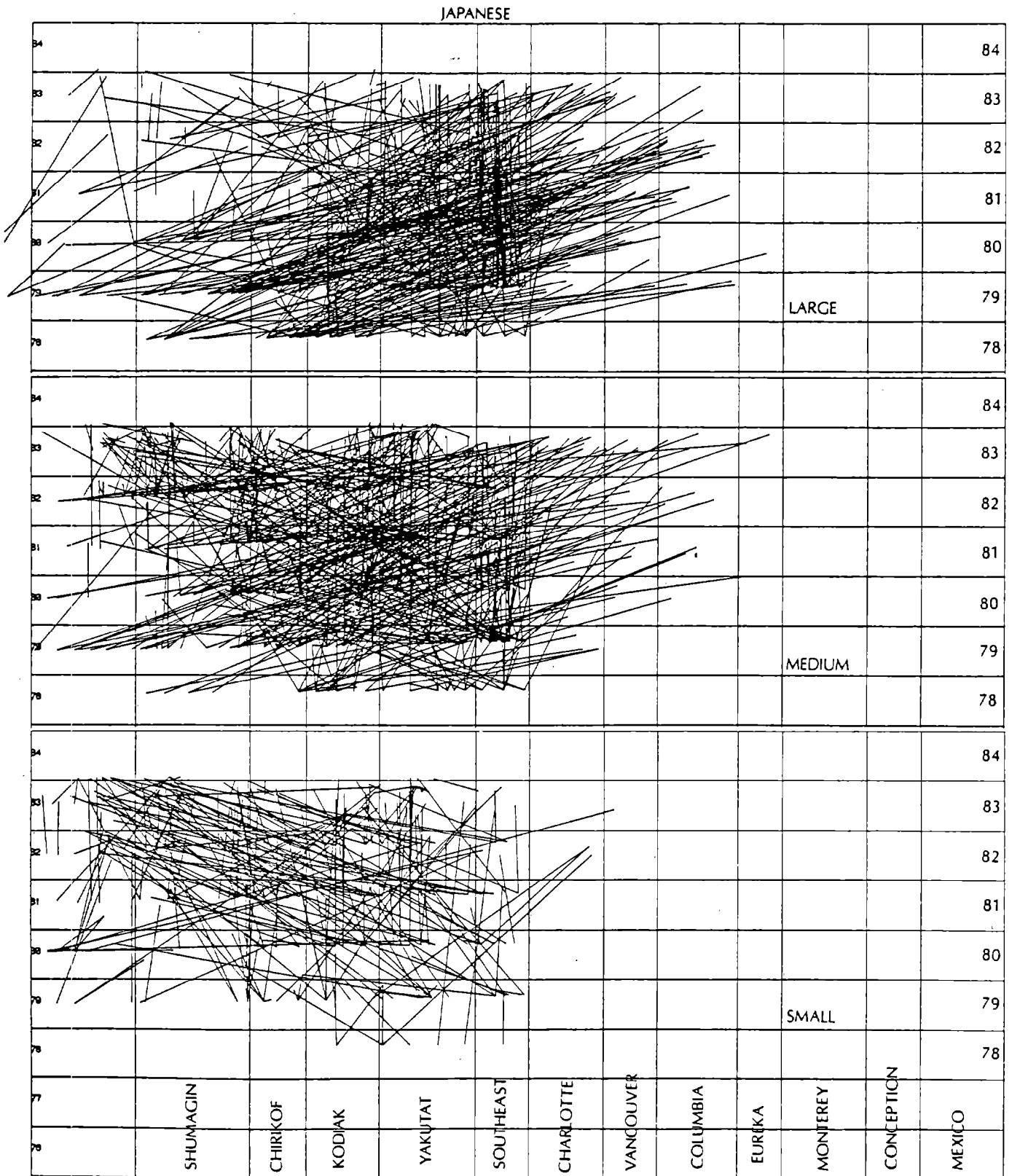


Figure 3. --Release-recovery traces of sablefish (Anoplopoma fimbria) tagged by Japan in 1977-83.



## CANADA

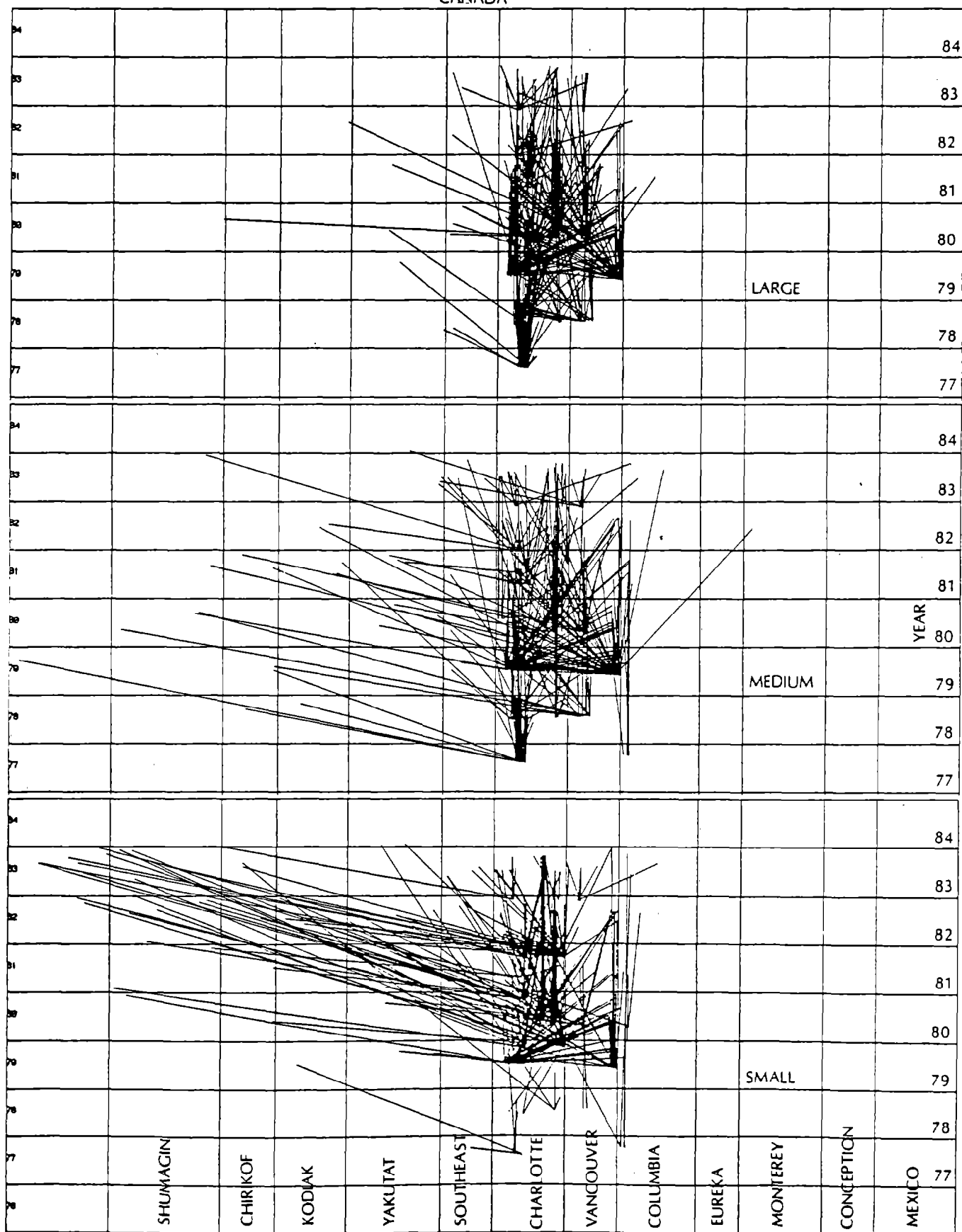


Figure 4.--Release-recovery traces of sablefish (Anoplopoma fimbria) tagged by Canada in 1977-83.

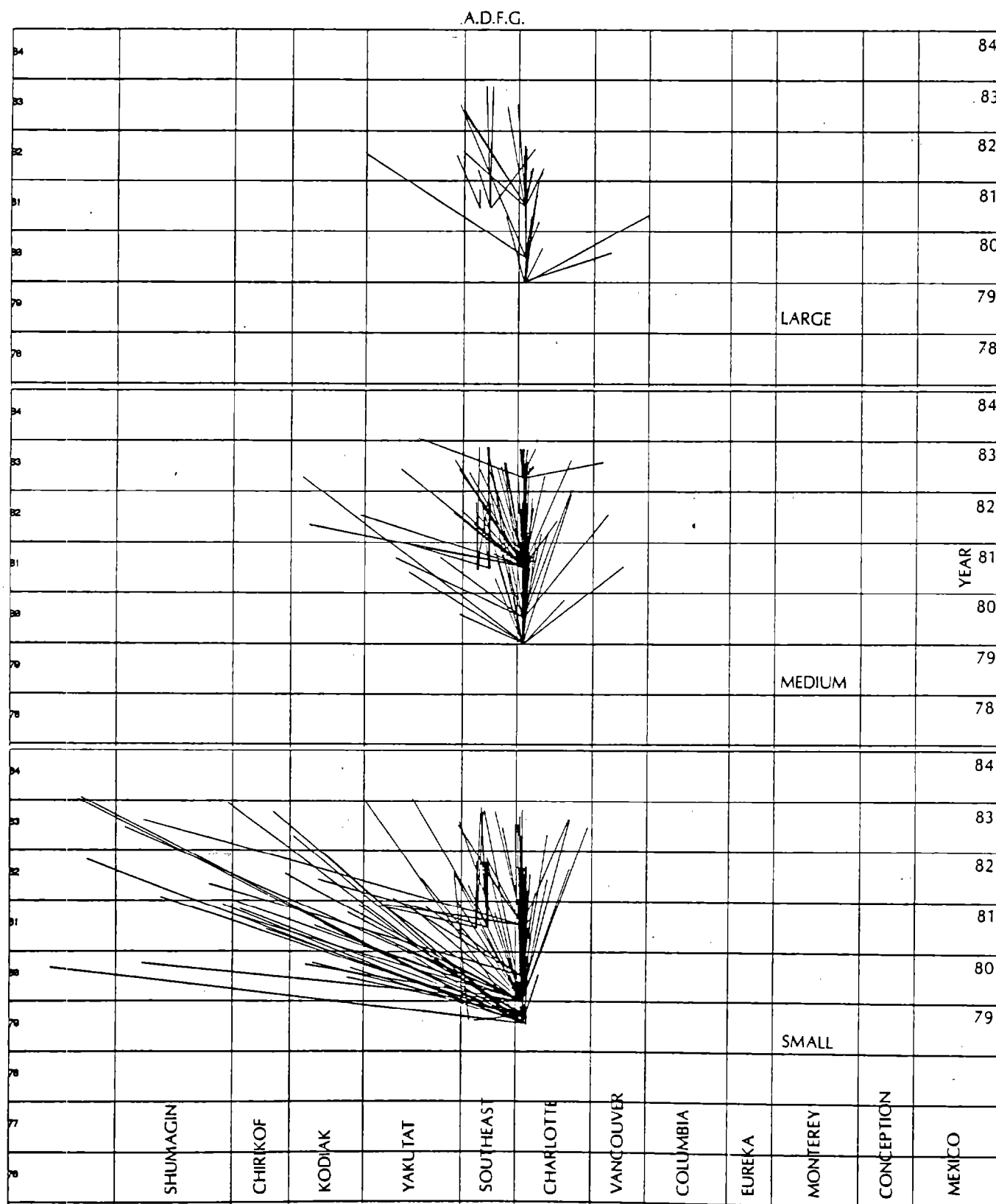


Figure 5. --Release-recovery traces of sablefish (*Anoplopoma fimbria*) tagged by the Alaska Department of Fish and Game in 1977-83;

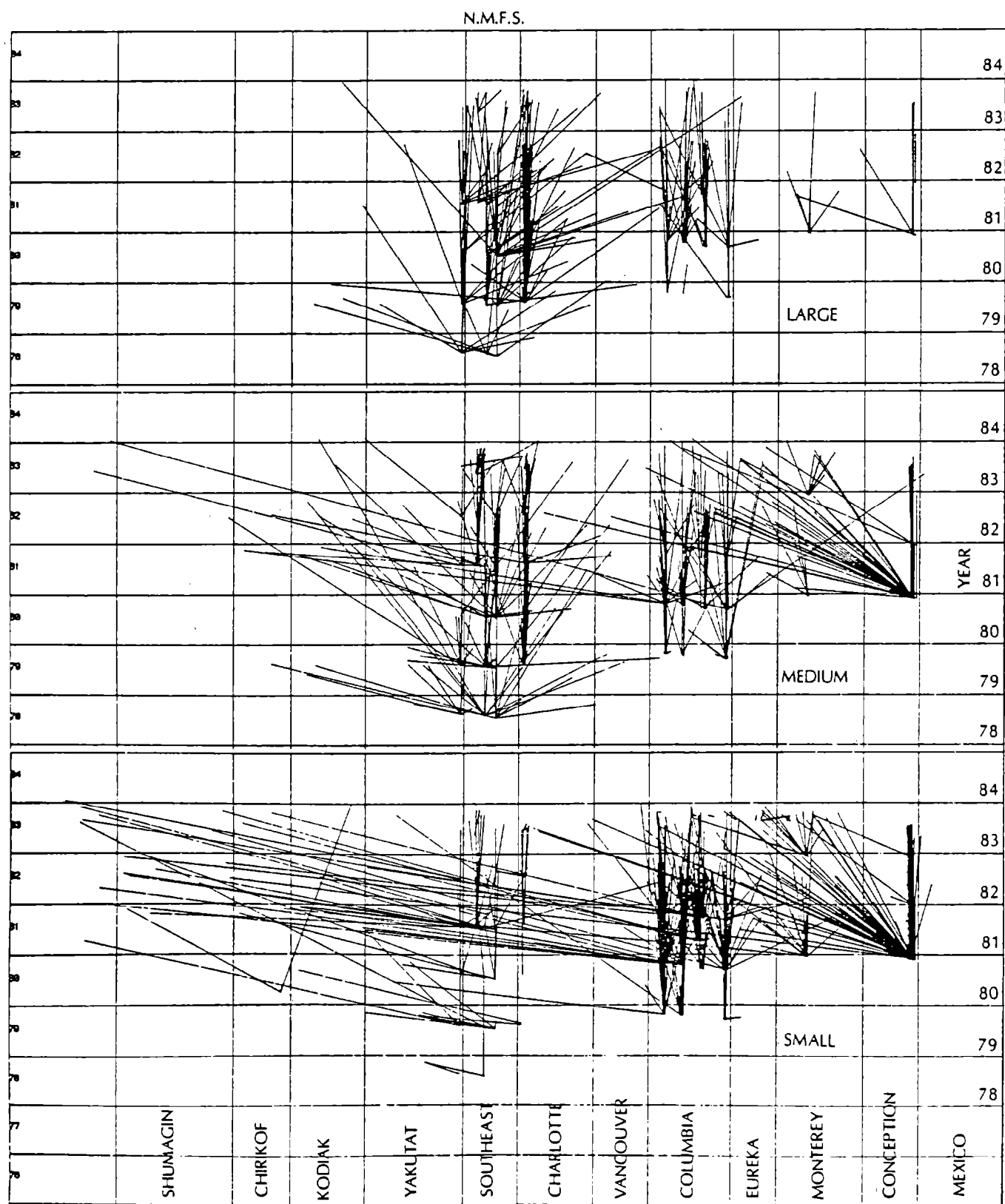


Figure 6. --Release-recovery traces of sablefish (*Anoplopoma fimbria*) tagged by the National Marine Fisheries' Service in 1977-83.

The most noticeable pattern in the data is the difference in direction or amount of movement between size groups. For example, small fish from all releases showed a stronger tendency to be captured north or westward from their release sites than did large fish. Large fish released by Japan, many of which were released in the more westward areas (Fig. 3), showed a strong tendency toward clockwise or southward and eastward movement. Large fish released by Canada, ADF&G, and NMFS, primarily in the more southern and eastern areas (Figs. 4, 5, and 6), contrasted with small fish by an absence of substantial northward or westward movement, rather than by strong clockwise movement.

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# APPENDIX

## Auxiliary Programs to Tagging Data Base

Program Name	Function
100 A/Formats (05/25/84)	Listing of formats for RACE files.
200 Find/Release (05/25/84)	Associate release information with tag recovery.
300 Find/Tag (05/25/84)	Find a tag in the master data base.
400 Generate/Tag/Index(05/25/84)	Generate/update the tag index file.
500 List/Recovery (05/25/84)	Print an unformatted tag recovery file.
600 List/Release (05/25/84)	Print and unformatted tag release file.
700 List/Tag/Index (05/25/84)	Print an unformatted tag index file.
800 Make/Bine/Recovery (05/25/84)	Convert a character recovery file to unformatted.
900 Make/Bine/Release (05/25/84)	Convert a character release file to unformatted.
1000 Make/Recovery (05/25/84)	Convert an unformatted recovery file to character.
1100 Make/Release (05/25/84)	Convert an unformatted release file to character.
1200 Merge/Bine/Recovery (05/25/84)	Merge two unformatted recovery files.
1300 Merge/Bine/Release (05/25/84)	Merge two unformatted release files.
1400 Select/Cruise/Recovery (05/25/84)	Select tag recovery data from master data base.
1500 Select/Cruise/Release (05/25/84)	Select tag release data from master data base.
1600 Sort/Bine/Recovery (05/25/84)	Sort an unformatted recovery file.
1700 Sort/Bine/Release (05/25/84)	Sort and unformatted release file.

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Appendix--Continued.

Program Name	Function
1800 Sort/Recovery (05/25/84)	Sort a character recovery file.
1900 Sort/Release (05/25/84)	Sort a character release file.
2000 Tag/Plotwork (05/25/84)	Generate a plot work file and binary lines from tagging data
2100 Tag/Report (05/25/84)	Print a report of tag release and recovery data.